# UT1 INTENSIVE OBSERVING SESSIONS REVISITED

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## INTRODUCTION

VLBI Intensives sessions (INTs) are performed to provide daily UT1 measurements between irregular occurring 24 h sessions. INTs have a duration of one hour and are observed on small networks:

- INT1: Kokee (KK), Wettzell (WZ)
- INT2: Tsukuba (TS), WZ
- INT3: Ny Ålesund (NY), TS, WZ

Thus, there is a weak observing configuration which leads to systematically different UT1-estimates.



$\Delta$UT1 w.r.t. IERS 08C04 (smoothed)

INT1 —   INT2 —   INT3 —
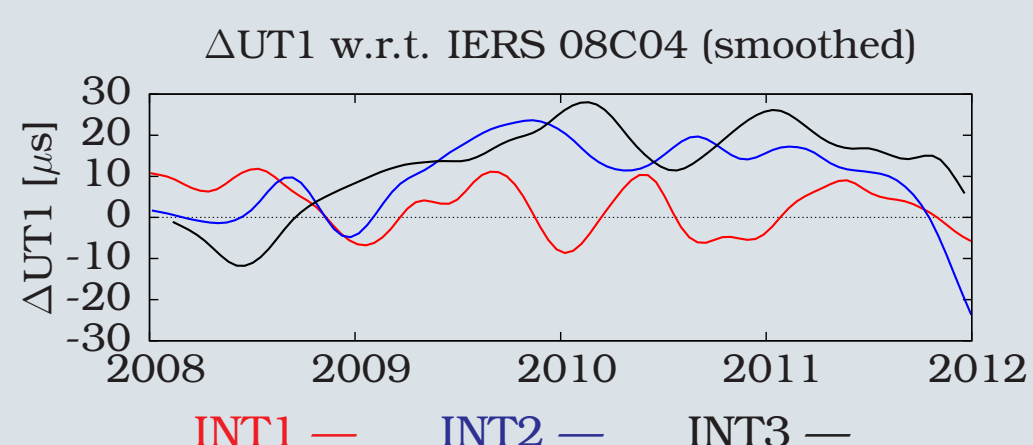
Furthermore, a negative impact of the INTs in an inter-technique combination in comparison to excitations by geophysical fluids was shown, e.g. by [2].

## DATA

To overcome the deficiencies and to improve INTs, investigations have been carried out

- R&D sessions with 1 h KK–WZ databases and 24 h databases for the remaining network ([1], R&D 907–910 and 1001–1005)
- extension to 2 h (INT-3 in late 2011, and INT-2 in early 2012)

For comparisons, (a) the subsequent 1 h R&D-INTs were added to 2 h durations, and (b) the original 2 h INTs were split up into 1 h durations.

## ANALYSIS OPTIONS

The analysis set-up for INTs is and has to be different from 24 h sessions. Here, some modifications are made:

- constant troposphere (AT) vs. continuous picewise linear function (CPWLF) ATs
- least squares (LSQ) collocation [3] vs. classical LSQ adjustment
- modified re-weighting via variance component estimation (VCE)

## LSQ-COLLOCATION & RE-WEIGHTING

In a LSQ adjustment, time variable parameters can be set-up with CPWLF over certain time-spans. In contrast, parameters can be handled as stochastic parameters with the LSQ-collocation method. Both approaches are different from standard INT-processing where ATs are estimated as constant parameters once per session.

Furthermore, a re-weighting of the observations is done here via VCE which only changes the estimates for sessions with more than one baseline.

### 2 H INTs IN 2011/2012



standard —   VCE —   CPWLF AT —   LSQ-collocation —
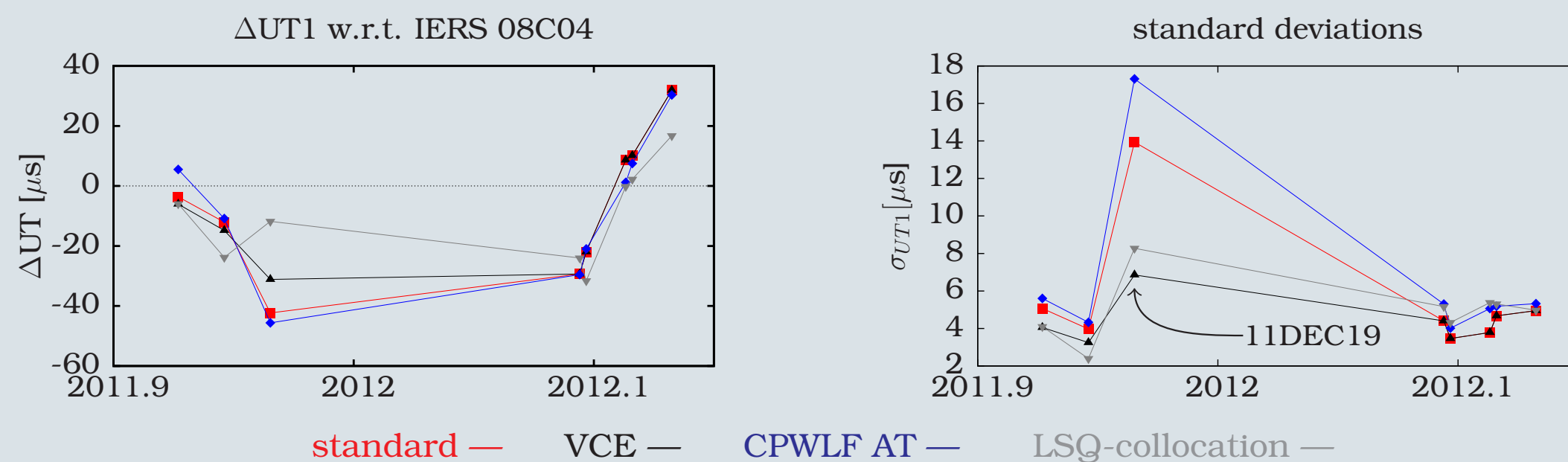
For the UT1 estimates, the impact of modified AT handling has significant impacts. The re-weighting by VCE leads to significant changes of the estimates only for sessions where large differences between the post fit residuals of individual baselines exist (e.g., 11DEC19). However, the re-weighting reduces the standard deviations.

### R&D-INTs

For the R&D-sessions, the RMS and WRMS of the INT UT1 estimates w.r.t. the offsets of the corresponding 24 h sessions were calculated. Compared to the standard approach, the repeatability of UT1

| approach | WRMS [$\mu$s] | RMS [$\mu$s] |
|---|---|---|
| standard | 19.2 | 23.9 |
| CPWLF | 18.6 | 23.3 |
| LSQ-colloc. | 18.6 | 22.0 |

is better if 30 min CPWLF ATs are used. A slightly bigger enhancement is gained by using stochastic ATs within the LSQ-collocation method.

## 2 H VS. 1 H INTENSIVES

Comparison of UT1 from

- dedicated 2 h long test INTs
- stacking of sub-sequent 1 h KK–WZ R&D-sessions to 2 h sessions
- simulations of 1 h and 2 h INTs for 3 months

in a LSQ adjustment with VCE re-weighting and 30 min CPWLF ATs applied.


all sessions: sorted standard deviations

As expected, the standard deviation of UT1 from the 1 h INTs is by a factor of approximately $\sqrt{2}$ bigger than the one from the 2 h INTs The standard deviation of the average UT1 of two successive 1 h INTs is on the same level.


INT2/INT3: $\Delta$UT1 w.r.t. IERS 08C04
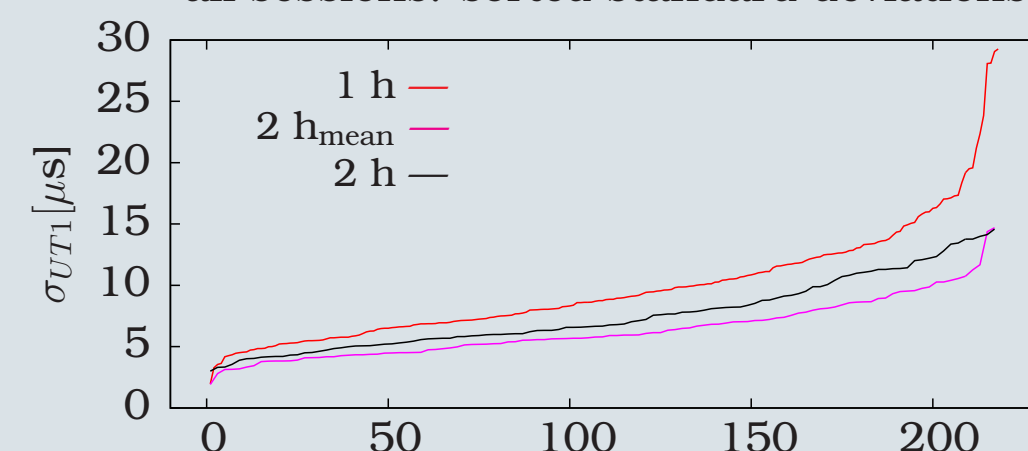
Concerning the parameters, the subsequent 1 h INTs differ by up to 80 $\mu$s. The estimates are exemplarily shown for the 2 h INTs. Furthermore, the RMS differences of UT1 from 2 h INTs vs. 1h INTs (R&D-sessions) to the UT1 estimates of the 24 h sessions is about 15% lower.

## CONCLUSIONS & OUTLOOK

For some special Intensives, non-standard analysis options have been used. For 2 h INTs, a parameterization of time variable AT seems useful. Especially the LSQ-collocation approach is a promising method to realize this. Furthermore, a re-weighting via VCE has been implemented. In this way, the 3 baseline INTs provide much more stable results.
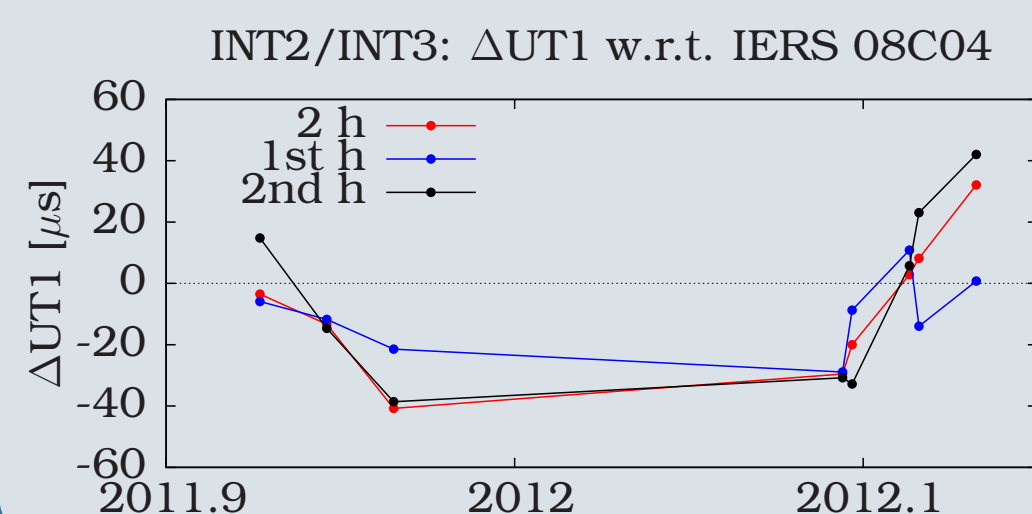
Concerning the time span of the INTs, the 2 h approach is promising. As expected, the 1 h INTs are smoothed and the standard deviations are lowered by a factor of approximately $\sqrt{2}$ due to twice as many observations.

## REFERENCES

[1] K. D. Baver, J. M. Gipson, and D. S. MacMillan. Strategies for Improving the IVS-INT01 UT1 Estimates: Preliminary Results of RD0907 through RD0910. In *IVS 2010 General Meeting Proceedings*, p. 256–260. 2010.

[2] K. Senior, J. Kouba, and J. Ray. Status and Prospects for Combined GPS LOD and VLBI UT1 Measurements. *Artificial Satellites*, 45(2):57–73, 2010.

[3] O. Titov. Estimation of the subdiurnal UT1-UTC Variations by the Least Squares Collocation Method. *Astronomical and Astrophysical Transactions*, 18:779–792, 2000.

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